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INTERIM REPORT
DESIGN AND DEVELOPMENT OF KLYSTRON
OSCILLATORS V-39 AND V-40



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COPY NO. 23

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INTERIM REPORT

DESIGN AND DEVELOPMENT OF KLYSTRON

OSCILLATORS V-39 AND V-40

For Period: 1 June to 31 August 1953

Prepared for

Bureau of Ships

Navy Department


on

BUSHIPS CONTRACT NObsr-52105
Index No. NE-110244


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SEPTEMBER 1953

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PURPOSE

The purpose of the program engaged under BuShips Contract No. NObsr-52105 is to design and develop two wide-range klystron oscillators, V-39 and V-40, which will comply with the specifications outlined in this contract.

The two oscillators will cover the frequency band from 10 to 21 kmc. One tube will tune over the lower half of the band from 10 to 15.5 kmc, and the other will cover the band from 15 to 21 kmc. Preliminary design tubes of each type, complete with electrical test and characteristic data, will be furnished. In addition, five tubes embodying the final design of each type will be supplied, along with electrical characteristics and test data, final proposed specifications, and manufacturing drawings.

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GENERAL FACTUAL DATA

Originally, five V-40 tubes were built. One of these tubes did not have the required 50 mw power output. This tube will be an interim tube and will be replaced by another V-40 tube as soon as possible.

One of the four satisfactory V-40 tubes has been shipped to the Navy and is in use at the Hewlett-Packard Company. Thus, including the interim tube mentioned above, there are four tubes ready for shipment.

A difficulty was encountered in the V-40 cavity. The plunger was found to be sticking to the waveguide walls. This was remedied by chromium-plating the plunger.

Tests of the successful V-40 tubes on hand showed a typical tube to have 50 - 100 mw power output (with matched load) over a half-power bandwidth of 15 mc (at $n = 3\text{-}3/4$) or of 20 mc (at $n = 4\text{-}3/4$).

The external cavity for the V-39 tubes has been redesigned with its coupling irises repositioned to avoid interaction between irises. This interaction had prevented oscillations at some frequency within the tuning range. A prototype of the new cavity has been started and is almost completed. Four acceptable V-39 tubes are available for insertion in the newly designed cavities when they are finished.

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DETAILED FACTUAL DATA

Five V-40 tubes had been built in previous months. One of these tubes did not meet the requirement for 50 mw power output, having only 19.5 mw at 21 kmc. This tube will be an interim tube and will be replaced by another V-40 tube as soon as possible.

One of the four satisfactory V-40 tubes has been shipped to the Navy and is in use at the Hewlett-Packard Company. Thus, including the interim tube mentioned above, there are four tubes ready for shipment.

In the V-40 cavity, some trouble was experienced in moving the contacting plunger in the waveguide. The plunger was sticking to the waveguide walls because of a silver-to-silver contact. The difficulty has been remedied by chromium plating the plunger, and this cavity is now satisfactory.

Tests were conducted of the four V-40 tubes. Results of these tests, witnessed by the Inspector of Naval Material, are summarized to indicate the characteristics of a typical tube as shown in Table I.

TABLE I

Beam voltage	- 750 v
Beam current	- 35 ma
Heater voltage	- 6.5 v
Heater current	- 1.2 amp

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TABLE I (Continued)

Reflector voltage (n = 3-3/4 mode, 15-19 kmc) (n = 4-3/4 mode, 19-21 kmc)	- 200-500 v
Power output (matched load)	- 50-100 mw
Half-power bandwidth @ n = 3-3/4 @ n = 4-3/4	- 15 mc - 20 mc
Plunger travel (15-21 kmc)	- 3/4 in.
Frequency resetability (function of plunger friction)	- < 0.1%
Modulation sensitivity @ 17 kmc	- 0.22 mc/v
Noise deviation	- 100 kc
Frequency change with altitude (0-50,000 ft.)	- 4 mc

In the external cavity for the V-39 tubes, it was discovered that two of the coupling irises to the mode suppressors were interacting to form a resonant structure. This structure prevented the tube from oscillating at some frequency within the tuning range. The cavity has therefore been redesigned and the coupling irises repositioned so that no interaction takes place.

A prototype of this new V-39 cavity has been started and is now about 90 per cent completed. There are four acceptable V-39 tubes available to be placed in the new cavities when they are finished. The fifth V-39 has been given to the Navy and is in use at the Hewlett-Packard Company.

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CONCLUSIONS

There are four V-40 tubes on hand ready to be shipped. Three of these tubes have a power output of at least 50 mw over a half-power bandwidth of 15 mc (at $n = 3\text{-}3/4$) or of 20 mc (at $n = 4\text{-}3/4$).

The external cavity for the V-39 tubes has been redesigned and a prototype of this new cavity is nearly completed. Four acceptable V-39 tubes are on hand to be inserted in the new cavities when they are finished.

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PROGRAM FOR NEXT INTERVAL

The four V-40 tubes will be shipped.

The newly designed cavities for the V-39 tubes will be constructed.

Estimated expenditures during August 1953: \$2,380.00

Estimated man-hours during August 1953: 230.0

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